

**Report on the Cod By-catch in the
1981-83 Newfoundland Capelin Trap
Fisheries**

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NEWFOUNDLAND CAPELIN TRAP FISHERIES

by

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ABSTRACT

Stevenson, S. C., A. D. Murphy, and R. B. Stead. 1984. Report on the cod by-catch in the 1981-83 Newfoundland capelin trap fisheries. Can. Tech. Rep. Fish. Aquat. Sci. 1310: iv + 15 p.

A study was conducted to estimate the quantities of juvenile cod caught during the 1981-83 capelin trap fisheries in NAFO Div. 3L and to assess the impact which such by-catch might have on the Div. 2J3KL cod stock. Cod by-catch occurred at low levels, with estimates ranging from 2.4 to 6.6% for each of the study years. The majority of this by-catch was below an acceptable commercial size (i.e. <40 cm) and, as such, about 77% was estimated as being discarded alive. Although the quantities of young cod caught may be visibly alarming, the estimated numbers of juvenile cod actually killed represent between .1 and .2% of the estimated recruitment at age 4 for the Div. 2J3KL cod stock and would probably have little effect on the future recruitment and abundance of this stock. By-catch of species other than cod were estimated to be very low.

RÉSUMÉ

Stevenson, S. C., A. D. Murphy, and R. B. Stead. 1984. Report on the cod by-catch in the 1981-83 Newfoundland capelin trap fisheries. Can. Tech. Rep. Fish. Aquat. Sci. 1310: iv + 15 p.

On a mené une étude afin d'estimer les quantités de jeunes morues capturées entre 1981 et 1983 pendant la pêche de capelan, à l'aide de parcs en filet dans la division 3L de l'OPANO, et d'évaluer les répercussions que pourraient avoir ces prises accessoires sur le stock de morues de la division 2J3KL. Les prises accessoires de morues ont été faibles, les estimations variant de 2,4 à 6,6% pour chacune des années étudiées. La majorité de ces prises n'atteignaient pas une taille commerciale acceptable (c.-à-d. longueur inférieure à 40 cm) et, comme tel, on a évalué à environ 77% la proportion de celles qui ont été rejetées vivantes. Bien que les quantités de jeunes morues capturées puissent paraître alarmantes, le nombre estimé de jeunes morues effectivement tuées ne représente que 0,1 à 0,2% de recrutement évalué à 4 ans pour le stock de morues de la division 2J3KL, ce qui aurait vraisemblablement peu d'effets sur le recrutement et l'abondance futures de ce stock. Les prises accessoires d'espèces autres que la morue sont considérées comme très faibles.

INTRODUCTION

A significant increase in capelin trap landings occurred in Newfoundland around 1979 and 1980 (Table 1). This expansion of the capelin trap fishery was associated with the closure of the NAFO¹ Div. 3L (Fig. 1) offshore capelin fishery in 1979, as well as the opening up of a lucrative frozen female capelin market in Japan around that time. In recent years, capelin trap landings have increased from 2,079 t in 1978 to around 10,885 t in 1983. Over the five year period, 1979 to 1983, about 96% of all Newfoundland capelin trap landings occurred in NAFO Div. 3L, with Trinity and Conception Bay landings accounting for the majority of these (Table 2).

Capelin traps, although normally smaller in circumference and depth, are similar in design to the Newfoundland cod trap (see Brothers (1983)) with modifications in construction and variations in dimensions occurring between traps, usually in response to local conditions in which they are fished. Drying twine² mesh sizes normally range from 16 to 19 mm with meshes in other portions varying considerably between traps, but generally being around 89 mm. These traps are normally fished in shallow water (9-27 m range) adjacent to the shoreline. A capelin trap can be hauled from one to many times a day depending on the availability of capelin and access to markets. The fishery usually begins around mid-June and normally terminates by mid-July. In recent years, strict monitoring of quotas and enforcement of opening and closing dates by the Department of Fisheries and Oceans have restricted the fishery to only 2 to 3 weeks duration in some areas.

Concern has been expressed by fishermen in recent years that considerable quantities of undersized cod are being caught as a by-catch in capelin traps (Anon, 1982). The fear is that significantly large numbers of juvenile cod are being destroyed to adversely affect the future of the cod stocks involved. The present study was initiated to document first-hand the types and quantities of by-catch occurring in capelin traps, especially with regard to cod by-catch, and to assess the impact which such by-catch might have on the future recruitment and abundance of the cod stocks involved.

METHODS

The study was conducted during the 1981, 1982, and 1983 capelin trap fishing seasons. Trinity and Conception bays were chosen as study areas because of the high levels of capelin trap landings there relative to overall Newfoundland capelin trap landings. Limited manpower resources and the shortness of the capelin trap season made it necessary to confine the study to specific locations and a limited number of fishermen in each successive year.

¹Northwest Atlantic Fisheries Organization.

²Drying twine refers to mesh used in the back portion of the trap where fish are held as hauling the trap nears completion.

During 1981 the Heart's Desire and Islington area of Trinity Bay was chosen as the study site, in 1982 the Harbour Grace and Carbonear area of Conception Bay was chosen, and during 1983 the study site was in the Dildo area of Trinity Bay (Fig. 2). These specific sampling sites were chosen because of their historically high capelin trap landings and the relatively high concentration of capelin trap fishermen there.

The study involved using two observers each year, working either alone or in pairs, to accompany selected capelin trap fishermen to the fishing grounds. Only active capelin trap fishermen were asked to participate in the study and no problems were encountered with fishermen unwilling to cooperate. During a particular year, as many fishermen as could be reasonably covered within a given sampling site were chosen. It was originally intended to randomly choose each fisherman to be accompanied on alternate days to the fishing grounds. However, due to irregularities inherent in fishing operations and the fishery itself, it was often necessary to choose a fisherman as the opportunity arose. Every effort was made to spread the coverage evenly among all fishermen selected in a particular study site and to monitor all traps from the time they were put in the water until they were taken up for the season. This coverage did vary from trap to trap within a particular year and among years. A summary of sampling coverage by year is given in Table 3.

Information on each capelin trap monitored during the study (i.e. dimensions, mesh sizes, location, and depth set) was collected during interviews with participating fishermen. A set detail sheet was completed for each haul observed with detailed information on the amount of capelin and by-catch caught. The total weight of fish caught in each haul was estimated for each species by landed and discarded categories. Estimates of the quantity of fish discarded were further broken down into those fish released alive and those dead on release. A combination of practical difficulties including small size of vessels used, large catches, inability to separate catches by haul once taken onboard, and release of unsuitable catches without being taken onboard, dictated that catches could not normally be separated and weighed. Most estimates were, therefore, visual ones. Because all observers involved were experienced personnel with fairly extensive involvement with such commercial fishing operations, it was felt that the estimates made for capelin and cod by-catch were quite reliable. Estimates of by-catch other than cod, however, were probably minimum ones in view of their relatively small numbers mixed in with large capelin and cod catches. It was felt that these estimates should be viewed with caution and, apart from a summary of their relative occurrence by species group, were combined in a miscellaneous category throughout this report.

Random length measurements of cod by-catch before any discarding took place were obtained whenever possible. Fork lengths were measured and recorded to the nearest centimetre using standard measuring strips offset by .5 cm. Length measurements were later combined into 3 cm groupings for analysis. Sample weights were calculated using the length-weight relationship:

$$W \text{ (kg)} = .00000864 L \text{ (cm)}^{3.01} ,$$

a formula in common use for the past number of years by this Branch in calculating sample weights of commercial cod length frequencies for use in annual stock assessments. This formula seems valid for the purpose used since good agreement was found between available sample weights and weights calculated using this formula.

Age keys used in estimating age compositions of cod by-catch were composite keys, combining otoliths collected from non-commercial size fish taken in capelin traps with otoliths collected during the regular inshore commercial sampling program in Div. 3L during the June-August period for each year.

In the estimation of the total weight of cod by-catch caught (including fish discarded alive) during the 1981 to 1983 Div. 3L capelin trap fisheries, the ratios of the observed total weight of cod caught to observed capelin landed were computed and applied to the nominal catches of capelin by trap in Div. 3L for each of the three years involved. Similarly, estimates of the total weight of cod actually killed during these years were estimated by calculating the ratios of observed cod killed to observed capelin landed and by applying these figures to nominal catches of capelin by trap for each year.

In order to derive estimates of cod by-catch, in terms of numbers and size categories of fish, length frequencies were first weighted by total catch per haul and then combined for a given year. These combined frequencies were adjusted up by weight to the total estimated amount of cod by-catch caught and to the total estimated amount of cod actually destroyed during the Div. 3L capelin trap fishery each year.

RESULTS AND DISCUSSION

CAPELIN CATCHES

Catch breakdowns for each of the hauls observed are summarized by trap in Tables 4, 5, and 6. Capelin catches amounted to 90.7%, 97.6%, and 97.1% of the total catch for all species for the years 1981 to 1983, respectively. Of the approximately 634,000 kg of capelin catch observed, around 206,000 kg or 32.5% were not landed but were discarded either alive or dead. It was estimated that only about 3% of all capelin discarded were actually killed. Taking into account the somewhat subjective nature of the mortality estimates and the fact that they are probably minimum ones, it would probably be more appropriate to conclude that mortality of discarded capelin was at a very low level, rather than take 3% as a definitive estimate. From results of research logbook surveys for the 1981 to 1983 capelin trap fisheries, Nakashima (1984) also noted significant capelin discarding (between 12-29% of total capelin caught) with the mortality of these discarded capelin being estimated at low levels. In all three years, Nakashima (1984) found that the major reason for capelin discarding by trap fishermen was a low percentage of females in the catch, which is consistent with the results of this study.

COD BY-CATCH

The cod by-catch for each of the hauls observed is summarized by trap in Tables 4, 5, and 6. For the years 1981 to 1983, cod amounted to 6.6%, 2.4%, and 2.6%, respectively of the total catch for all species. From results of research logbook surveys for the same time period, Nakashima (1984) also concluded that the by-catch of cod was low, representing less than 1.5% of the reported logbook landings in all three years.

Estimated weights of cod both caught and killed during the Div. 3L capelin trap fisheries are given in Table 7. The estimated percentage of cod by-catch killed ranged from 10.9% in 1981, 42.9% in 1982, and 34.8% in 1983, with an overall weighted mortality estimate of 23.3% for all years combined. It was estimated that 942, 310, and 479 metric tons of cod were caught during the 1981 to 1983 capelin trap fisheries, however, only 103, 133, and 167 metric tons were estimated as actually being killed during these years, respectively. In terms of numbers of fish, an estimated 458,000, 438,000, and 831,000 cod were killed during these fisheries, respectively (Table 8).

Length compositions of the cod by-catch for the three years are shown in Fig. 3. Mean lengths were 27.8, 30.1, and 26.9 cm for years 1981 to 1983, respectively. The majority of cod caught were less than 40 cm in length, which is the length generally considered the minimum acceptable commercial size for cod by most Newfoundland fish processors. In terms of numbers, 99.3%, 88.5%, and 98.8% of all cod caught were below an acceptable commercial size for the years 1981 to 1983, respectively. Indeed, in most instances, it was of no economic benefit for fishermen to keep catches with such a high proportion of undersized fish and, hence, the high levels of discarded cod reported.

Percentage age compositions of the cod caught in the capelin traps during the study period are presented in Fig. 3. In all three years catches were comprised primarily of 2 and 3 year olds, with ages ranging from 1 to 6 years. Such an occurrence of juvenile cod in capelin trap catches in the study areas is not surprising, since the bays of eastern Newfoundland are believed to be nursery areas for the progeny of adults from the Labrador East-Newfoundland cod stock (Lear and Wells, 1984). Estimates of the numbers of cod killed by age group for the Div. 3L capelin trap fisheries are given in Table 9. These were derived using age compositions of cod caught during the study period.

The long-term average recruitment at age 4 for the Div. 2J3KL cod stock has been estimated at around 400 million fish (NAFO, 1983). Although the numbers of young cod caught by capelin traps may be visibly alarming, the estimated quantities of juvenile cod killed annually during each of the study years (i.e. 458,000 in 1981, 438,000 in 1982, and 831,000 in 1983) represent between .1 and .2% of this estimated recruitment at age 4. It is unlikely that such relatively low removal rates would have any significant effect on the recruitment and abundance of the Div. 2J3KL cod stock. Even if the worst scenario occurred and all cod caught were killed, this would only represent between .3 and 1.1% of the estimated recruitment at age 4 and still would probably not present a major problem.

OTHER BY-CATCH

Estimated quantities of by-catch other than cod are summarized in Tables 4, 5, and 6. The by-catch of miscellaneous species was low in all three years, with estimates of only 2.7%, <.1%, and .3% of the total catch for years 1981 to 1983, respectively and the overall estimate being .3% for the three years combined. Even though these estimates are probably minimum ones for reasons outlined earlier in this report, it was estimated that about 91% of all miscellaneous by-catch was discarded alive, making it a relatively insignificant problem. Nakashima (1984) also reported the occurrence of miscellaneous species by-catch in extremely small numbers from his research logbook data collected during the same time period.

The relative occurrence of the miscellaneous by-catch by species group is presented in Table 10. Composition of miscellaneous by-catch varied by year and sampling site, with winter flounder, cunner, ocean pout, haddock, and herring representing 88% of all miscellaneous by-catch during the study period. The by-catch of such high profile species as salmon and sea trout were relatively insignificant during the study period.

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Table 1. Newfoundland landings of capelin by capelin trap 1974-83 (landings in metric tons).

Year	NAFO Division				Total
	3K	3L	3Ps	4R	
1974	233	728	29	-	990
1975	86	792	1	-	879
1976	162	953	-	-	1,115
1977	245	1,009	-	-	1,254
1978	447	1,632	-	-	2,079
1979	42	5,552	-	-	5,594
1980	139	5,661	29	2	5,831
1981	283	7,917	-	1	8,201
1982	381	8,845	44	4	9,274
1983 ^a	344	10,416	125	-	10,885

^aPreliminary figures

Table 2. NAFO Division 3L landings of capelin by capelin trap broken down by bay for years 1979-83 (landings in metric tons).

Year	Bonavista Bay	Trinity Bay	Conception Bay	Southern Shore	Trepassey + St. Mary's Bays
1979	45	1,149	4,264	93	-
1980	119	1,719	3,566	242	15
1981	62	2,271	5,522	52	-
1982	139	2,496	5,919	312	9
1983 ^a	524	4,564	5,262	5	12
% 1979-83	2%	32%	64%	2%	-

^aPreliminary figures

Table 3. Summary of 1981-83 capelin by-catch study sampling coverage.

Year	Bay	Sampling site	Dates	Depths (m)	# Traps monitored	# Hauls observed
1981	Trinity Bay	Heart's Desire/Islington Area	June 16-July 4	9-14	5	36
1982	Conception Bay	Hr. Grace/Carbonear Area	June 15-July 9	11-18	11	87
1983	Trinity Bay	Dildo Area	June 15-June 30	13-27	11	46

Table 4. 1981 observed catches summarized by capelin trap (weights in kilograms^a).

Trap	# Hauls	Capelin			Cod				Miscellaneous			
		Kept	Discarded		Kept	Shack ^c	Discarded		Kept	Shack	Discarded	
		Market ^b	Live	Dead	Market		Live	Dead	Market		Live	Dead
A	7	340	91		5		1,696				156	8
B	8	6,010	3,175	363			368				353	2
C	3	9,072	9,072	3,629	286	3	474	7			40	1
D	9	5,636	1,134		14	11	191		39		679	
E	9	6,396	161	16		23	190				59	
Total		27,454	13,633	4,008	305	37	2,919	7	39		1,287	11

^a weights given in Tables 4, 5, and 6 were originally estimated in pounds and later converted to kilograms.

^b market refers to fish landed for sale.

^c shack refers to fish unsuitable for sale (i.e., oddfish, undersized, or poor quality).

Table 5. 1982 observed catches summarized by capelin trap (weights in kilograms).

Trap	# Hauls	Capelin			Cod				Miscellaneous			
		Kept	Discarded		Kept	Shack	Discarded		Kept	Shack	Discarded	
		Market	Live	Dead	Market		Live	Dead	Market		Live	Dead
A	8	454	15,966			5	1,114				16	4
B	8	21,319	3,935	181	340	275	459				38	
C	12	21,319	76,430		136	39	1,174		5		2	
D	5	14,742	1,588		921	154	793			3	6	
E	4	12,701	3,493		272	125	170	181			84	
F	5	16,783	8,255	816	295	125	703				1	
G	14	89,131	4,990		45	386	646				8	
H	15	52,390	13,971	771	290	152	878	18	2			
J	8	32,659	227			814	322			9	20	
K	4	30,391				48	77					
L	4	26,308	1,361	454		5	122				5	
Total		318,197	130,216	2,221	2,299	2,128	6,458	199	7	12	180	4

Table 6. 1983 observed catches summarized by capelin trap (weights in kilograms).

Trap	# Hauls	Capelin			Cod				Miscellaneous			
		Kept Market	Discarded		Kept Market	Shack	Discarded		Kept Market	Shack	Discarded	
			Live	Dead			Live	Dead			Live	Dead
A	3		227				39				88	
B	6	16,465				34	499	2				20
C	3	2,722	23			23	16			3	4	
D	7	29,937	28,803			689	363			5	16	
E	6	7,484	1,134			34	396	17		6	38	
F	3	7,938				209	23			21		
G	8	13,154	24,993		91	102	885			5	84	2
H	2	363	91			5	29			5	18	
I	3	1,134	680			48	14			1	5	
J	4	2,722	45			68	147		2	1	54	34
K	1		45				23					
Total		81,919	56,041		91	1,212	2,434	19	2	47	307	56

Table 7. Estimated weights of cod caught and killed during Division 3L capelin trap fisheries.

Year	Observed ratio cod caught/ capelin landed	Observed ratio cod killed/ capelin landed	Div. 3L by trap (MT)	Total capelin landed in 3L by trap (MT)	Total estimated cod caught by 3L capelin traps (MT)	Total estimated cod killed by 3L capelin traps (MT)
1981	.119	.013		7,917	942	103
1982	.035	.015		8,845	310	133
1983	.046	.016		10,416	479	167

Table 8. Estimated numbers of cod caught and killed during 1981-83 Division 3L capelin trap fisheries.

Year	Mean weight cod by-catch (kg)	Estimated number of cod caught ($\times 10^{-3}$)	Estimated number of cod killed ($\times 10^{-3}$)
1981	.225	4,187	458
1982	.304	1,019	438
1983	.201	2,383	831

Table 9. Estimated age compositions of cod killed by Div. 3L capelin trap fisheries for years 1981-83 (000's of fish).

Age	1981	1982	1983
1	39	8	8
2	141	176	384
3	236	162	404
4	40	85	28
5	2	6	6
6		1	1
Total	458	438	831
Weight (MT)	103	133	167

Table 10. Relative occurrence of miscellaneous by-catch by species group.

1981			1982			1983		
Species	#hauls occurred out of 36 obs.	% of misc. by-catch	Species	#hauls occurred out of 87 obs.	% of misc. by-catch	Species	#hauls occurred out of 46 obs.	% of misc. by-catch
Winter fld.	22	58.7	Ocean pout	8	26.5	Haddock	22	41.2
Cunner	32	18.7	Winter fld.	6	24.4	Herring	5	31.9
Ocean pout	15	12.3	Herring	3	15.2	Winter fld.	7	11.4
Sculpin	22	8.6	Cunner	16	14.1	Other	2	4.5
Sand launce	7	1.0	Lumpfish	4	7.4	Skate	1	2.7
Skate	1	.5	Skate	1	4.5	Lumpfish	3	2.3
Sea trout	1	.1	Sculpin	4	4.1	Sand launce	4	1.8
Herring	1	.1	Salmon	2	3.8	Cunner	4	1.6
						Yellowtail	1	1.1
						Sea trout	3	1.0
						Salmon	2	.3
						Ocean pout	1	.2

Fig. 1. Map showing locations of various NAFO Divisions referred to in the text.

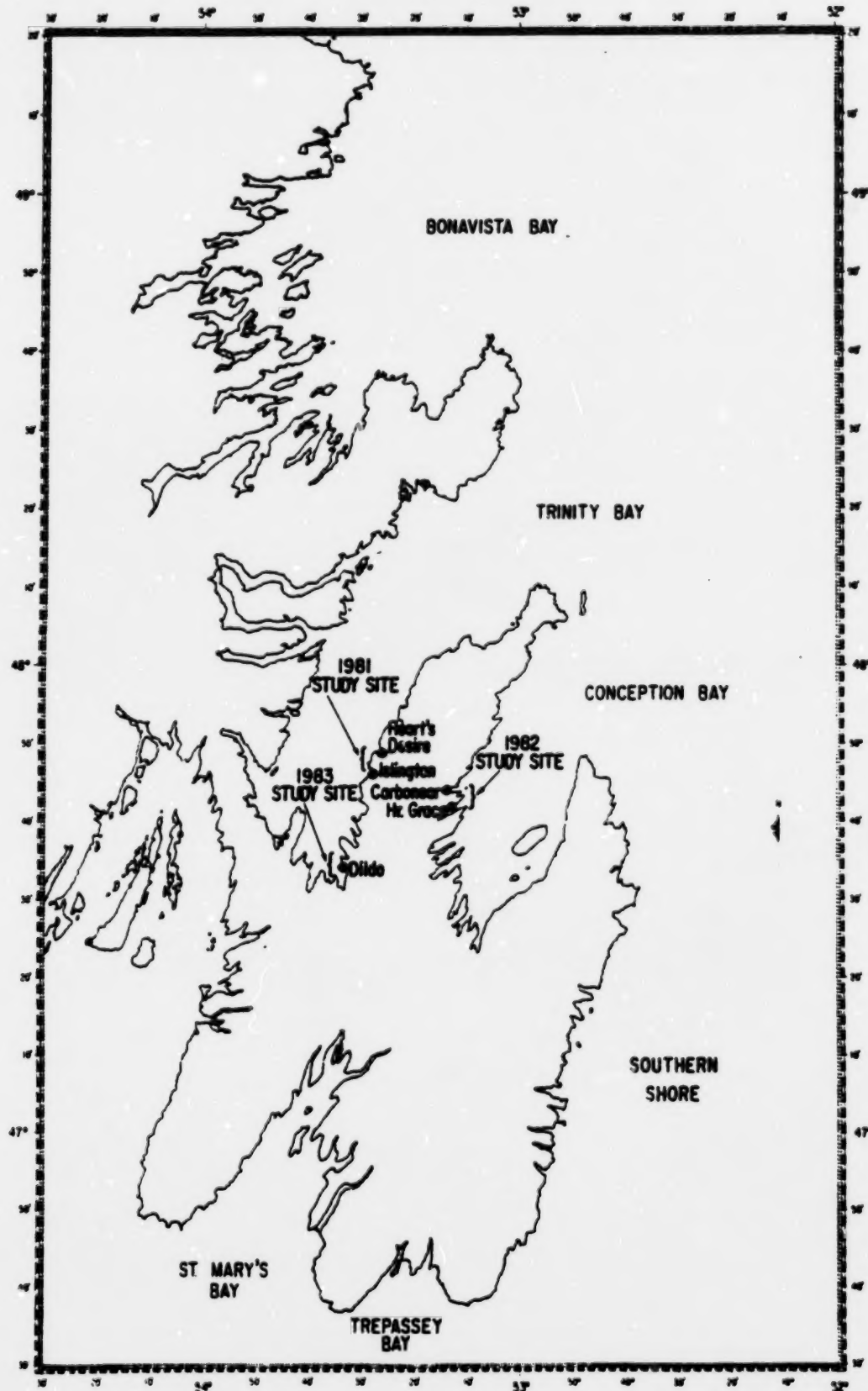


Fig. 2. Locations of study sites for 1981-83 by-catch study.

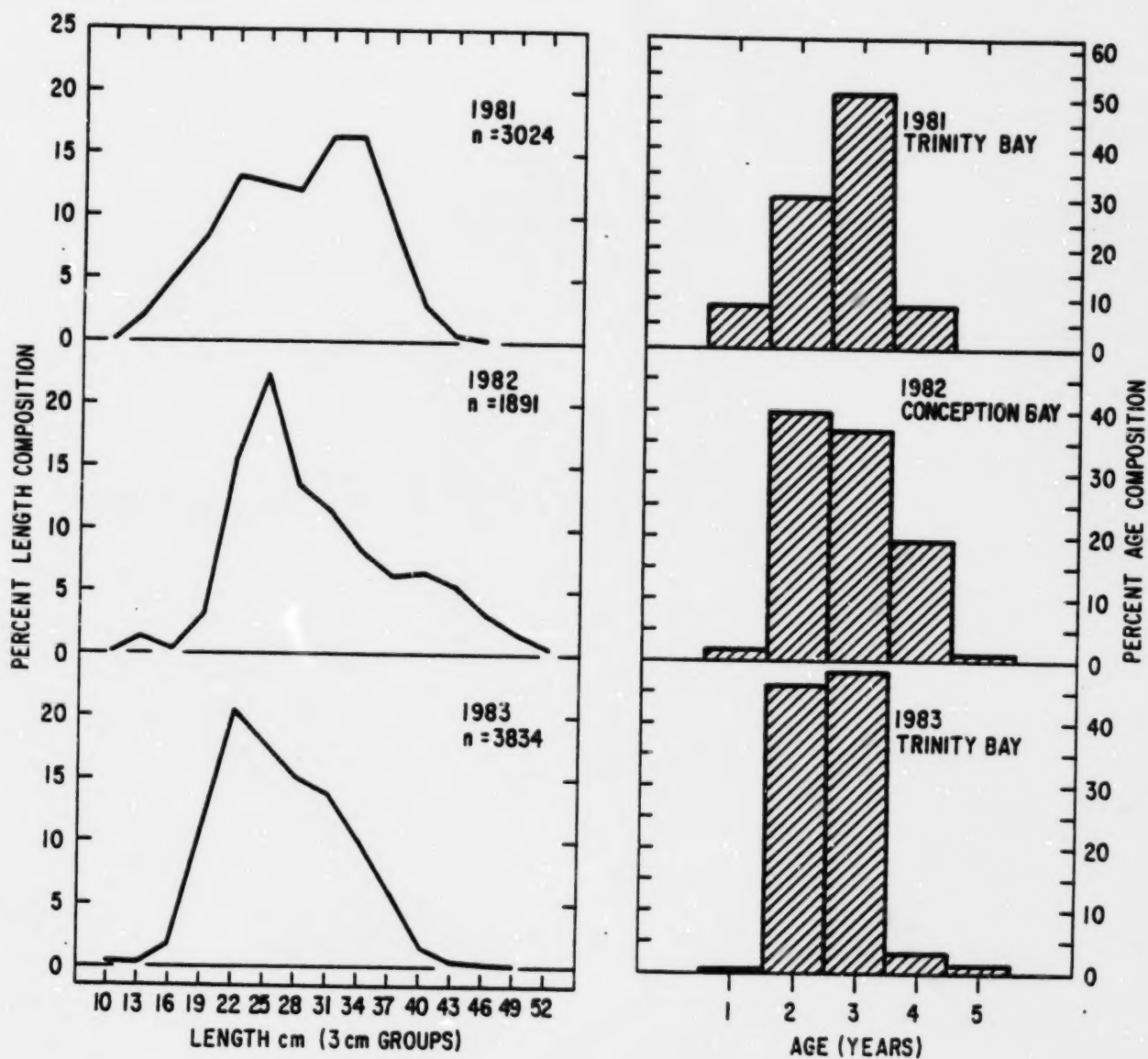


Fig. 3. Length and age composition of cod caught during 1981-83 capelin trap by-catch study.